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Cold Regions Research & Engineering Laboratory

Ice Engineering

U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire

Ice Jams, Winter 2000–2001

During winter months, rivers, lakes, and streams freeze in cold regions. Ice jams form during initial ice cover formation as the ice accumulates, restricting water flow (freezeup jam), and also form when the ice cover breaks up and clogs the river downstream (breakup jam). When the river becomes jammed with ice, backwater flooding can cause costly damage to low-lying areas and municipal structures.

Riverine communities upstream of the jam can suffer severe effects as a result of backwater flooding. Communities downstream of the jam can also be affected by a rapid surge of water and ice that is released when a jam breaks. Because it is difficult to predict when jams will occur or release, there is little time to prepare for flooding. Bridges, roads, and buildings often are damaged by the resulting excessive water and ice. Roads and runways (Fig. 1) can be forced to close, and bridges can be damaged or destroyed, delaying or limiting emergency medical aid in evacuation situations. Transportation of heating fuel and other necessary cargo can be temporarily halted.

Ice movement can disturb riverbeds and riverbank vegetation, affecting fish habitat and wildlife. Because of the rapidity of events, engineers and other officials often have little time to evacuate or mitigate the jam to prevent costly damages. Ice jam damages have been estimated to cost the United States $100 million annually.

Figure 1. The Yukon River at Koyukuk, Alaska, flooded 95% of the 3000-foot runway at the Koyukuk Airport when an ice jam backed up water on 25 May 2001. (Photo courtesy of Alaska Division of Emergency Services.)

Engineers and officials are working together to create methods to predict when and where ice jams will occur, to prevent jams from forming, and to avoid serious damages from jams that do form. These projects rely on accurate data to help prepare communities for future ice events. The Cold Regions Research and Engineering Laboratory (CRREL) Ice Jam Database is a compilation of freezeup and breakup ice jam events in the United States (White 1996). There are currently more than 12,500 entries in the database, the earliest occurring in 1780. CRREL's database is a reliable resource used to research previous ice jams and to assess specific situations that may cause ice jam formation. Each entry includes river name, latitude and longitude, city and state, U.S. Geological Survey (USGS) gage number if available, USGS hydrologic unit code, jam type and date, local and CRREL contacts, a summary of the event, and a list of publications on the jam. The database can also serve as a source of documented responses from engineers and officials who helped relieve the emergency situations.

This issue provides an overview of ice events that occurred during water year (WY) 2001 (1 October 2000–30 September 2001). There are 132 entries in the database for this year, which is about average. Most of the field condition information was obtained through daily bulletins from the National Weather Service (NWS). Other sources of information include Corps and CRREL personnel and Internet articles.

When did ice jams occur in 2001?

During WY 2001, ice jams most frequently occurred during March. March jams accounted for 30% of the reported events while January had a total of 25%. December, February, and April experienced their share of events with 17, 11, and 10 percent respectively. The remaining 7% of jams occurred in Alaska during May and June (Fig. 2).

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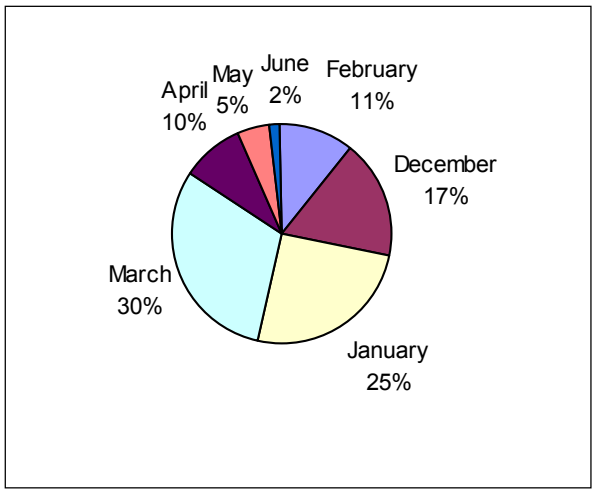

Figure 2. Months in which ice jams were reported.

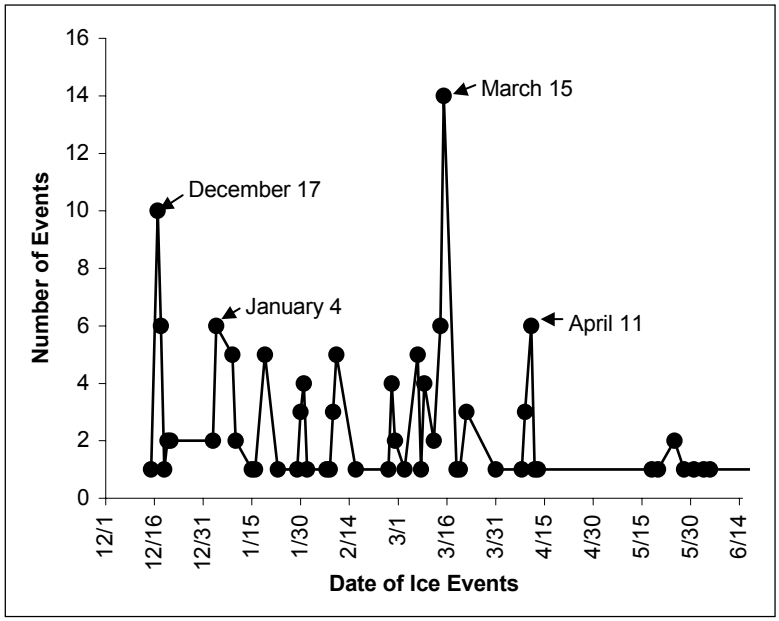

Figure 3. Dates that ice jams occurred during WY 2001.

December's ice jams occurred between the 15th and the 21st, when warm temperatures and rain caused ice covers to break up and jam; 77% were located in northern New England and New York. Event peaks throughout January and into February tended to occur in two-day increments approximately every six to nine days. These increments generally consisted of seven or eight jams (Fig. 3). Only one jam was reported between the 11th and 25th of February: it took place on the 16th on the Androscoggin River in Hastings, Maine. By 26 February, additional ice events occurred as warm temperatures and heavy rain fell over the central United States, especially in Iowa and Illinois.

Over 80% of March events occurred from the 7th to the 15th, with 14 events reported on the 15th. This was primarily due to rising temperatures in Iowa and Nebraska, where 90% of the jams occurred during this time. These warmer temperatures caused the snow to melt and the rivers to rise suddenly, resulting in breakup and movement of the ice cover, leading to jams in many locations. April had 12 events between the 9th and the 13th, with 75% in northern New England and New York. The other 25% occurred in Minnesota and Michigan. All eight of the Alaska jams occurred between 17 May and 4 June.

A review of the previous five years' data shows that most jams occurred during either January or February. During the 1996 and 1999 seasons, a very high percentage of jams occurred during January, while ice jams in both 1997 and 2000 occurred more frequently in February. Jams in 1998 were similar to those of 2001, in that both experienced about 30% of ice jams in March and about 11% in February.

Where did ice jams occur in 2001?

Twenty states ranging from Maine to Alaska and as far south as Kentucky were affected by ice jams during WY 2001 (Fig. 4). Maine had the highest number of jams (17), while Pennsylvania, Nebraska, and New York each had 16, 15, and 13 respectively (Fig. 5).

Six of Maine's jams were on the St. John River, which had the second highest number of jams in WY 2001. Over half of Maine's 17 jams occurred in December; with the exception of one, they occurred on the 17th and 18th. In mid-December, warm temperatures and heavy rain caused the breakup of ice covers on Maine rivers, leading to jams. Many of these jams froze in place during subsequent cold periods, causing fears that later ice cover breakup could result in serious jams.

The Allegheny River in Pennsylvania saw the most events on one river with nine jams (Fig. 6). All 16 of Pennsylvania's jams happened during January. Mixed snow and rain on 18 January could have increased river levels, resulting in breakup and jamming.

Approximately 87% of Nebraska's jams occurred during March when warm weather caused snowmelt, increasing river levels and causing ice to break apart and jam. The Platte River, Nebraska's largest contributor, had six ice events, all of which occurred on the 14th or 15th of March. Other rivers that jammed during this time were the Loup and the Elkhorn, each having at least two jams.

New York's ice jams were scattered across the state and the season from December to April, averaging three events per month. The two main regions of New York where events occurred were the northeastern region containing the Ausable River and Great Chazy River, and the western region near Buffalo, where Cazenovia Creek is located.

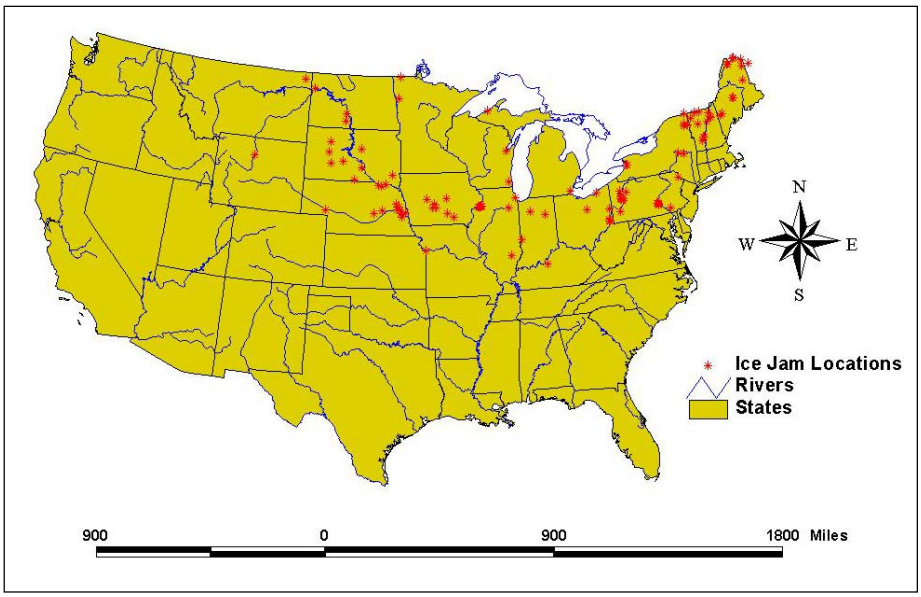

Figure 4. Ice jam locations during WY 2001.

Major ice events during 2001

Two major events were the ice jam on the Youghiogheny River at McKeesport, Pennsylvania, which destroyed a marina, and the jam on the Rock River, Illinois, which flooded four towns and caused more than 200 people to evacuate. Other jams causing significant damage included events at Koyukuk, Alaska, on the Yukon River, and several events in March on Nebraska's Platte River. Several other jams around the country caused minor flooding and road closings.

Youghiogheny River, Pennsylvania

At 5:30 p.m. on 31 January, flooding caused by an ice jam began at the McKeesport Marina. At 8:55 p.m. it was reported that the entire 210-ft-long marina had been destroyed by chunks of ice up to 1 ft thick. Reports estimate that the damage began around 6:30 p.m., and at 8:37 p.m. the marina was torn away. About two hundred gallons of gasoline spilled into the water as a result of the ice damage. There were no reported injuries or evacuations, and no boats were docked at the marina at the time. The marina cost more than $2 million to build, and it is estimated that it will cost more than $1 million to reconstruct the facilities (Veltri 2001).

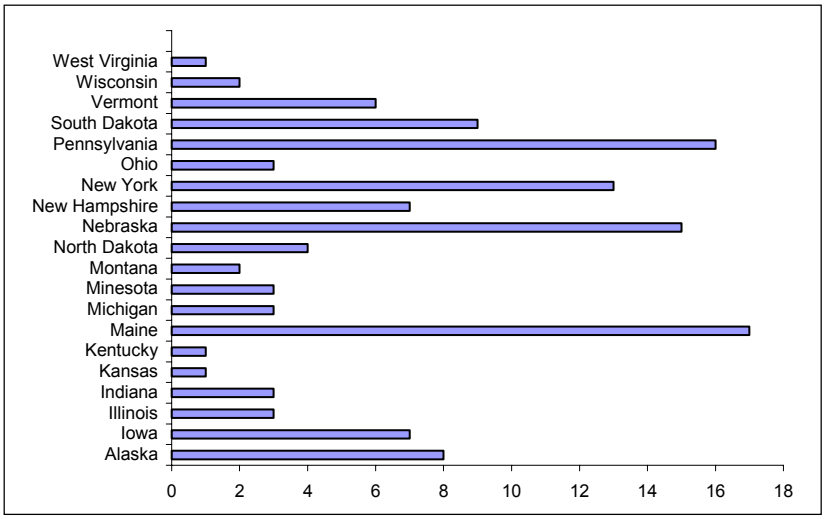

Figure 5. States where ice jams most frequently occurred during WY 2001.

Rock River, Illinois

On Monday, 26 February 2001, the Rock River jammed when ice and fallen trees began to move downstream and jammed at a series of bridges, including the Interstate 80 Bridge, Route 84 Bridge, and two railroad trestles. Ahead of the broken ice there were two miles of sheet ice frozen in place, preventing the ice from continuing downstream (Hemes 2001). The jam stretched upstream for seven miles (*Dominion Post* 2001).

By Tuesday the ice jam caused water upstream to rise at a rate of 10 inches per hour in some locations, causing the water to rise over three feet that day (Burleson 2001). More than 200 residents from Barstow, Osborn, and Cleveland had to be

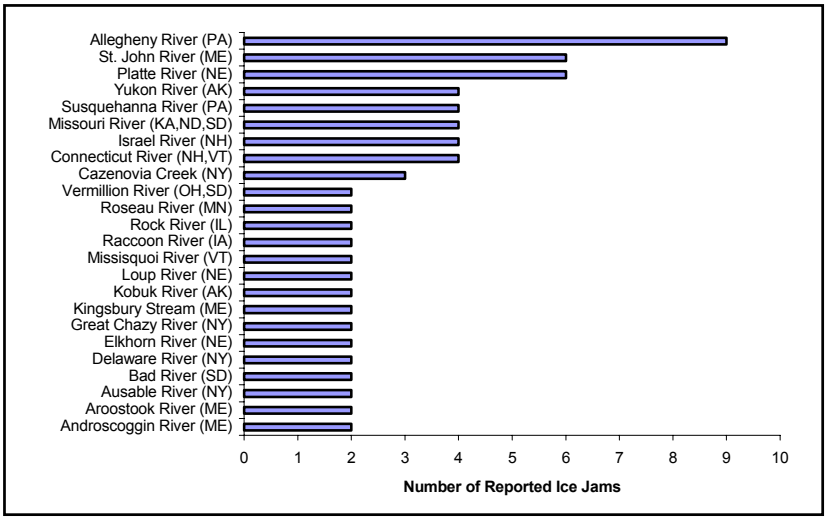

Figure 6. Number of events on rivers having two or more ice jams.

Figure 7. Flooding caused by ice jams on the Rock River. (AP photo; used with permission.)

evacuated because of the flooding. Cleveland residents were forced to evacuate when the only road out of town was flooded (Hemes 2001). Cleveland was submerged under four to five feet of water because of the jam (Burleson 2001) (Fig. 7). Approximately 80 residents were evacuated by boat, and some were rescued by helicopter (*Holland Sentinel* 2001) (Fig. 8). Among those rescued included a dozen patients from a nursing home. The Zuma Creek Levee upstream of Barstow was overtopped, causing major flooding in Barstow (NWS 2001b).

On Thursday, water levels had receded one foot. Some Cleveland residents were allowed to return to their homes, but others had to be returned by boat because of flooded roads (FEMA 2001). Other towns affected by the jam included Shady Beach, Ridgeview, Moline, and Joslin.

Platte River, Nebraska

Areas of Nebraska on the Platte River were hit hard with major flooding when ice jammed in several locations on 14 March. More than 100 residents were evacuated because of rising water and flooded homes. Water levels in Ashland exceeded normal levels by about six feet, and land was flooded for about 6.5 miles along the river between Yutan and Valley. Excessive flooding was due to temperatures rapidly rising into the 60s, which caused the snow to melt and the ice to break up and jam, producing large amounts of backwater flooding (*Lincoln Journal Star 2001*).

Yukon River, Alaska

On Friday, 24 May, the Yukon River jammed eight miles below Nulato, causing water levels at Nulato to rise and flood low-lying areas and the airport road. Water continued to rise further upstream at Koyukuk where one-third of the airport runway was flooded (Fig. 1), affecting transportation (NWS 2001). The jam remained in place until 27 May, when water levels began to subside around mid-afternoon.

In an article in the *Anchorage Daily News*, Benedict Jones Sr. said, "It was the worst flood in Koyukuk since 1963." The report also said that approximately one-third of the village's 35 homes were flooded, and some houses had up to six feet of water inside. Thirty-four villagers were evacuated between Friday and Monday evening. The town was flooded to the point that its generator almost shut down, and three dog teams had to be relocated to higher ground. In Nulato several homes were flooded, though not as badly as in Koyukuk. A few waste sites were flooded, including a sewage lagoon and a fuel tank farm where a sheen was spotted on the water. The water also came very close to Nulato's landfill (Manning 2001).

On Wednesday, 30 May, a team of volunteer agency personnel was sent to assess the disaster and to address the issues of temporary shelter, health and medical issues, damaged roads, bridges and airports, and recovery phases. No estimated costs of damage were given (Alaska Governor's Office 2001). On 31 May, Alaska's governor signed a flood disaster declaration for both Nulato and Koyukuk.

Corps of Engineers response

During the 2001 ice jam season, CRREL provided technical as well as financial and mechanical assistance to communities affected by ice jams and subsequent flooding. CRREL provided recommendations, referrals, on-site observations, and points of contact to the Corps of Engineers New England District and other regions. Ice jam observation, mitigation, and response training was provided to federal, state, and local agency personnel in Maine, New Hampshire, Vermont, Massachusetts, and Montana, with support from the New England and Seattle Districts.

Figure 8. Volunteer firefighters evacuate residents of Cleveland, Illinois. Photo courtesy of Quad Cities Online.

An example of CRREL's assistance was its technical assistance to New England District. A stage gage automated alarm was installed on the Israel River in New Hampshire in early January after the Israel River jammed in mid-December causing minor flooding (Gagnon and Arnold 2001). The jam froze in place, causing periodic overbank flooding as discharge changed. CRREL, along with the USGS, NWS, and state and local agencies, installed and monitored several ice motion detectors on the Kennebec River near Augusta, Maine. In late January the Army Corps of Engineers assisted the village of Abbot, Maine, on the Piscataquis River when the river jammed. The river had previously jammed in 1987 with damages estimated at $6 million. When the river began to jam this time, local officials sought the advice of the New England District and CRREL.

The unusually deep snowpack, combined with many early-season ice jams frozen in place, raised concerns that late-season jams could be very destructive in New England. With support from Headquarters, U.S. Army Corps of Engineers, the North Atlantic Division, and New England District, the Remote Sensing/Geographic Information Systems (RS/GIS) Center at CRREL developed and operated a Web site (http://www.crrel.usace.army.mil/icejams/) to provide rapid dissemination of ice observations and snow conditions. It is hoped that this effort will be expanded in the future.

How is this information helpful?

This overview of WY 2001 ice jams is the sixth in a series of yearly ice jam summaries. The Ice Jam Database is updated annually to provide an accurate summary of the previous water year ice events, including date of occurrence, location, damages, and Corps response. This historical information can be crucial to officials in emergency situations. Weather patterns, frequent jamming locations, water stage, flooded areas, and mitigation techniques are all pertinent factors when trying to predict ice jams and prevent potential damages. Knowing what situations have caused jamming and to what extent can help prepare a community for the effects of a jam.

CRREL also has an Ice Jam Archive containing hard copies of the information used in annual reports. Information sources include NWS reports, newspaper articles, and other reports used for information about current and past water years. These records can be photocopied or checked out for research purposes.

Please send information for the Ice Jam Database or Ice Jam Archive to Kate White, CRREL, 72 Lyme Road, Hanover, NH 03755-1290 (e-mail Kathleen.D.White@erdc.usace.army.mil).The Ice Jam Database is available via CRREL's Web site (http://www.crrel.usace.army.mil/) or can be directly accessed at http://www.crrel.usace.army.mil/ierd/ijdb/index.html.

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